

REMARKSStatus of Claims

Claims 1-11 are pending in the present application.

In the outstanding Office action, claims 1-11 are rejected under 35 U.S.C. § 102(b) or (e).

In the Amendment submitted herein, claim 4 is canceled, and claim 1 is amended to include the subject matter as set forth in the canceled claim 4. No new matter has been introduced as support for the amendment is found in the originally filed claims and specification. Entry of the amendment is respectfully requested.

Rejection: Under 35 U.S.C. §102(e)

Claims 1, 2 and 4-11 have been rejected under 35 U.S.C. §102(e) as being anticipated by Katsuya et al. (U.S. Patent No. 6,081,310).

In response, Applicants respectfully submit that the Katsuya reference was filed in the United States Patent and Trademark Office on November 4, 1998. The present application was filed on July 30, 1999 and includes a proper claim for priority made under 35 U.S.C. §119 and the International Convention for the Protection of Industrial Property to Japanese Patent Application No. Hei 10-218192 filed on July 31, 1998. To perfect this claim for priority, a copy of the English translation of the Japanese priority document is attached hereto (Attachment 1). Applicants submit that the claim to priority is herein perfected and that the foreign priority date of the present application antedates the Katsuya reference.

In the outstanding Office Action, the Examiner states that the document JP 09-322712 listed under Foreign Application Priority Data for the Katsuya reference would present grounds for rejecting claims 1, 2 and 4-11 in a case where the rejection based on Katsuya is overcome by perfecting the foreign priority by submitting a certified translation of the foreign priority document.

In response, Applicants submit that JP 09-322712 was filed on November 25, 1997 in Japan. As is known, applications in Japan publish generally eighteen months after filing or from a priority date. However, JP 09-322712 was *never published* and

instead only used as a basis of priority in the subsequent JP Application No. 10-222859, which is also listed as a foreign priority application in the Katsuya patent. This latter application, as published, is included herewith as Attachment 2. The attached document was published on August 10, 1999 and refers to JP 09-322712 only for priority purposes indicating that JP 09-322712 was never published and instead only used for priority purposes.

Thus, considering that JP 09-322712 was *never* published and that JP 10-222859 was only published *after* the filing of the present application, neither of these Japanese applications are proper prior art under 35 U.S.C. §102.

For the foregoing reasons, Applicants respectfully request reconsideration and withdrawal of the rejection of the anticipation rejection of claims 1, 2 and 4-11 under 35 U.S.C. § 102(e).

Rejection: Under 35 U.S.C. §102(b)

Claims 1-3 and 5-7 have been rejected under 35 U.S.C. §102(b) as being anticipated by Lu et al. (U.S. Patent No. 5,764,324).

As stated above, claim 1 is amended herein to include the subject matter as recited in the original claim 4. In this regard, Applicants note that claim 4 is novel over the Lu reference. Thus, the amended claim 1 is novel over the Lu reference.

Claims 2-3 and 5-7 are not anticipated by Lu as variously depending from a novel independent claim 1.

For the foregoing reasons, Applicants respectfully request reconsideration and withdrawal of the rejection of the anticipation of claims 1-3 and 5-7.

Conclusion

As discussed above, the Katsuya reference is antedated by submitting a certified English translation of the priority document, and JP application 09-322712 is not proper prior art against the claimed invention. Amended claim 1, and claims 2-3 and 5-7 depending therefrom are novel nonobvious over Lu and all cited references.

Accordingly, all the pending claims 1-3 and 5-11 are now allowable. Reconsideration and withdrawal of the outstanding rejections and allowance of all the

pending claims is respectfully requested.

The foregoing amendment and remarks fully comply with the Office Action.

The Examiner is invited to contact Applicants' attorneys at the below-listed phone number regarding the present response or otherwise concerning the instant application.

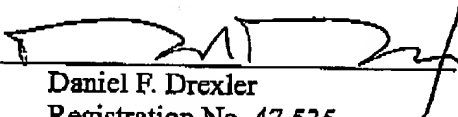
If there are any charges due with respect to this Amendment or otherwise, please charge them to Deposit Account No. 06-1130 maintained by Applicants' attorneys.

Respectfully submitted,

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MARKED UP VERSION TO SHOW CHANGES MADE

Claim 1 is amended as follows:

1 (Amended/Marked up) A reflective type liquid crystal display device on which display is created by reflecting light incident from the display observation side, comprising:

- a display electrode made of a reflective material for reflecting the incident light on a surface thereof; and
- a back-surface electrode disposed in contact with a back surface of the display electrode,

wherein said display electrode and said back-surface electrode are patterned into the same shape.

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CANTOR COLBURN, LLP

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ATTACHMENT 1

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DECLARATION FOR TRANSLATION

I, Jun Ishida, a Patent Attorney, of 1-34-12, Kichijoji-Honcho, Musashino-shi, Tokyo, Japan, do solemnly and sincerely declare that I well understand the Japanese and English languages and that the attached English version is a full, true and faithful translation made by me

this 19th day of October 2001


of the Japanese priority document of

Japanese Patent Application
No. Hei 10-218192

entitled "REFLECTIVE TYPE LIQUID CRYSTAL DISPLAY DEVICE".

In testimony thereof, I herein set my name and seal

this 19th day of October 2001


Jun Ishida
Patent Attorney

[Name of Document] APPLICATION FOR PATENT

[Identification No. of Document] KHB0980036

[Filing Date] July 31, 1998

[Addressee] Esq. Commissioner of the Patent Office

[IPC] 302F 1/133

[Title of the Invention] REFLECTIVE TYPE LIQUID CRYSTAL
DISPLAY DEVICE

[Number of Claims] 2

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[List of Filing Papers]

[Name of Item] Specification

[Number] 1

[Name of Item] Drawings

[Number] 1

[Name of Item] Abstract

[Number] 1

[General Power of Attorney No.] 9702954

[Necessity of Proof] Yes

[Name of the Document] Specification

[Title of the Invention] REFLECTIVE TYPE LIQUID CRYSTAL
DISPLAY DEVICE

[Claims]

- 5 [Claim 1] A reflective type liquid crystal display device in
which display is observed by reflecting light by a display
electrode made of a reflective material, said display device
comprising a back-surface electrode disposed in contact with a
back surface of the display electrode at the side opposite of
10 the observing side for the display of said display electrode.

[Claim 2] The device according to claim 1, wherein said back-
surface electrode is made of a high melting point metal.

[Detailed Description of the Invention]

[0001]

- 15 [Field of the Invention]

The present invention relates to a reflective type liquid
crystal display device provided with a display electrode made
of a reflective material.

[0002]

- 20 [Description of the Related Art]

A reflective type liquid crystal display device has been
proposed wherein a display is observed through reflection of
light incident from the observation direction.

[0003]

- 25 Fig. 2 shows a sectional view of such a conventional
reflective type liquid crystal display device.

[0004]

- 30 As shown in Fig. 2, the conventional reflective type
liquid crystal display device comprises an insulating
substrate 10 having an aluminum (Al) display electrode 18
connected to a switching element such as a thin film
transistor (hereinafter referred to as TFT) and an orientation
film 22 formed thereon, and an opposite electrode substrate 20
having an opposite electrode 21 and an orientation film 22

formed thereon. The substrates oppose each other and are bonded together by an adhesive seal agent 23. The void between the substrates is filled with a liquid crystal material such as twisted nematic liquid crystal (TN liquid crystal) 30. Moreover, a polarization plate 24 is provided on the side of an observer 100 outside the liquid crystal display device.

[0005]

Natural light 40 from the outside is incident upon the polarization plate 24 on the side of the observer 100. The light is transmitted through the opposite electrode substrate 20, the opposite electrode 21, the orientation film 22, the TN liquid crystal 30, and the orientation film 22 on the TFT substrate 10, and then reflected by the display electrode 18, transmitted through the layers in a direction reverse to the incident direction, and emitted via the polarization plate 24 on the opposite electrode substrate 20 to enter the observer's eyes 100.

[0006]

Fig. 3 shows a sectional view of one display pixel section of the typical conventional reflective type liquid crystal display device.

[0007]

A gate electrode 11 is formed on an insulating substrate 10 such as glass, and an active layer 14 made of polycrystalline silicon is formed via a gate insulating film 12 provided on the gate electrode 11. A stopper 13 made of an insulating film is formed on the active layer 14 and, using the stopper 13 as a mask, impurities are injected to the active layer 14 to form a source 14s and a drain 14d. A portion masked by the stopper 13 forms a channel 14c. An inter-layer insulating film 15 is formed on the stopper 13, the active layer 14 and the gate insulating film 12.

[0008]

The source 14s at one side is connected to an Al display electrode (source electrode) 18 via a contact hole formed on the inter-layer insulating film 15. The drain 14d at the other side is connected to an Al drain electrode 16 via a contact hole formed on the inter-layer insulating film 15. The insulating substrate 10 with TFT formed thereon, i.e., the TFT substrate 10, is completed in this manner.

[Problems to be solved by the Invention]

[0009]

However, since the display electrode is formed by depositing and patterning Al by a sputtering process, protrusions are generated on a display electrode surface during the formation by sputtering. Protrusions are also generated on the display electrode surface by heat treatment after the sputtering. As a consequence, drawbacks result in that a mirror-surface reflectance is lowered and that a bright display on which external light is sufficiently reflected cannot be obtained.

[0010]

The present invention is conceived to solve the above drawbacks and one object of the present invention is to provide a reflective type liquid crystal display device in which protrusion cannot easily be formed on the surface of the display electrode, the mirror-surface reflectance is enhanced, and a bright display can be obtained.

[0011]

[Means for solving the Problem]

A reflective type liquid crystal display device according to the present invention is a reflective type liquid crystal display device in which display is observed by reflecting light by a display electrode made of a reflective material, said display device comprising a back-surface electrode disposed in contact with a back surface of the display electrode at the side opposite of the observing side for the

display of said display electrode.

[0012]

Said back-surface electrode may be made of a metal with a high melting point.

5 [0013]

[Description of the Preferred Embodiment]

A reflective type liquid crystal display device according to the present invention will be described hereinafter.

[0014]

10 Fig. 1 shows a sectional view of one display pixel of the reflective type liquid crystal display device of the present invention.

[0015]

As shown in Fig. 1, a gate electrode 11 formed of a metal such as Cr is formed on an insulating substrate 10 such as glass, and an active layer 14 made of polycrystalline silicon is formed via a gate insulating film 12 constituted of an insulating film such as SiO_2 provided on the gate electrode 11. A stopper 13 made of an insulating film such as SiO_2 is formed on the active layer 14 and, using the stopper 13 as a mask, impurities are injected to the active layer 14 to form a source 14s and a drain 14d. A portion masked by the stopper 13 forms a channel 14c. An inter-layer insulating film 15 is formed on the stopper 13, the active layer 14 and the gate insulating film 12. A contact hole is formed on the inter-layer insulating film 15 at a position corresponding to the drain 14d and a drain electrode 16 is connected through this contact hole.

[0016]

30 A flattening insulating film 17 is then formed on the inter-layer insulating film 15 and the drain electrode 16, and a contact hole is formed in the inter-layer insulating film 15 and the flattening insulating film 17 at a position corresponding to the source 14s.

[0017]

Approximately 1000 angstroms of molybdenum (Mo) is deposited in the contact hole and on the flattening insulating film 17 by a sputtering process, and thereupon approximately
5 2000 angstroms of Al is similarly deposited by the sputtering process. Thereafter, a resist pattern for forming a display electrode 18 is formed on the Al, and the Al and Mo are etched in sequence, so that a display electrode 18 and a back-surface electrode 41 having the same shape as the display electrode 18
10 at the back surface of the display electrode 18 are formed. In this case, the source 14s is connected to the display electrode 18, which also acts as a source electrode, via the contact hole formed in the flattening insulating film 17 and the inter-layer insulating film 15 at the position
15 corresponding to the source 14s. The insulating substrate 10 with TFT formed thereon, i.e., the TFT substrate 10, is completed in this manner.

[0018]

As shown by the dotted line in Fig. 1, natural light 40
20 incident from the outside follows a route wherein it strikes a polarization plate 24 from the side of an observer 100; is transmitted through an opposite electrode substrate 20, an opposite electrode 21, an orientation film 22, a liquid crystal 30, and an orientation film 22 on the TFT substrate
25 10; and is then reflected by the display electrode 18 made of Al. The light is subsequently transmitted through the layers in a direction reverse to the incident direction and emitted via the polarization plate 24 of the opposite electrode substrate 20 towards the observer's eyes 100.

[0019]

When the back-surface electrode formed of a metal with a high melting point is provided on the back surface of the display electrode 18, the crystal grain diameter of the Al is reduced. As a result, stresses are suppressed and protrusions

are not easily generated on the surface.

[0020]

In addition to Mo, other high melting point metals such as titanium (Ti), tungsten (W), tantalum (Ta), and chromium (Cr) can be used as the material of the back-surface electrode 41. In particular, when Ti or W is used, the contact to the source 14s can be easily obtained, and thus, these metals are suitable as the material of the back-surface electrode. Furthermore, Ti is of a hexagonal system. When Ti is used, it is well compatible with Al of a face-centered cubic system in respect of a crystal lattice structure. Since Al is formed as a crystal surface which is easily placed in (111) orientation state, protrusions or bumps do not easily generate on the surface.

[0021]

Moreover, a twisted nematic liquid crystal (TN liquid crystal) having a birefringence control mode and using a polarization plate can be used as the liquid crystal material.

[0022]

As described above, by forming a high melting point metal such as Mo and Ti at the back surface of the display electrode 18 in the same shape as the display electrode, when the display electrode 18 is formed by the sputtering process, protrusions are not easily generated on the surface, even during the subsequent heat treatment. Moreover, the mirror-surface reflectance of the display electrode made of Al is not lowered, and a reflective type liquid crystal display device realizing a bright display can be obtained.

[0023]

Furthermore, the thickness of the back-surface electrode 41 may be in the range of 200 to 1500 angstroms to such a degree that no protrusions are generated on the display electrode 18.

[0024]

Moreover, while the use of a so-called bottom gate type TFT with a TFT gate electrode provided under the active layer in the reflective type liquid crystal display device has been described, similar effects can be obtained when the present invention is applied to a reflective type liquid crystal display device provided with a top gate type TFT in which the gate electrode is provided above the active layer.

[0025]

[Advantages]

With the liquid crystal display device of the present invention, there can be provided a reflective type liquid crystal display device in which protrusions or bumps are not easily generated on the display electrode surface, the mirror-surface reflectance is enhanced, and a bright display can be obtained.

[Brief Description of the Drawings]

[Fig. 1] A sectional view of one display pixel section of a reflective type liquid crystal display device according to the present invention.

[Fig. 2] An overall schematic sectional view of a conventional reflective type liquid crystal display device.

[Fig. 3] A sectional view of one display pixel section of a conventional reflective type liquid crystal display device.

[Explanation of Reference Numerals]

10 TFT Substrate
18 Display Electrode
20 Opposite Electrode Substrate
24 Polarization Plate
30 Liquid Crystal
40 Natural Light
41 Back-surface Electrode
100 Observer

[Name of the Document] Abstract of the Disclosure

[Summary]

[Problems] To provide a reflective type liquid crystal display device in which protrusions are not easily generated on a surface of an Al display electrode, the mirror-surface reflectance is enhanced, and bright display can be obtained.

[Structure]

A gate electrode 11, a gate insulating film 12, an active layer 14 with a source 14s and a drain 14d, an inter-layer insulating film 15, and a flattening insulating film 17 are laminated in that order on an Al insulating substrate 10. A display electrode 18 connected to the source 14s is provided on the flattening insulating film 17. The display electrode 18 is made of Al, and a back-surface electrode 41 constituted of Mo or Ti which is a high melting point metal is provided on the back surface of the display electrode 18, in order to prevent protrusions from being generated on the surface of the display electrode 18, and consequently, to enhance the mirror-surface reflectance of the display electrode 18 and obtain bright display.

[Selected Drawing] Fig. 1

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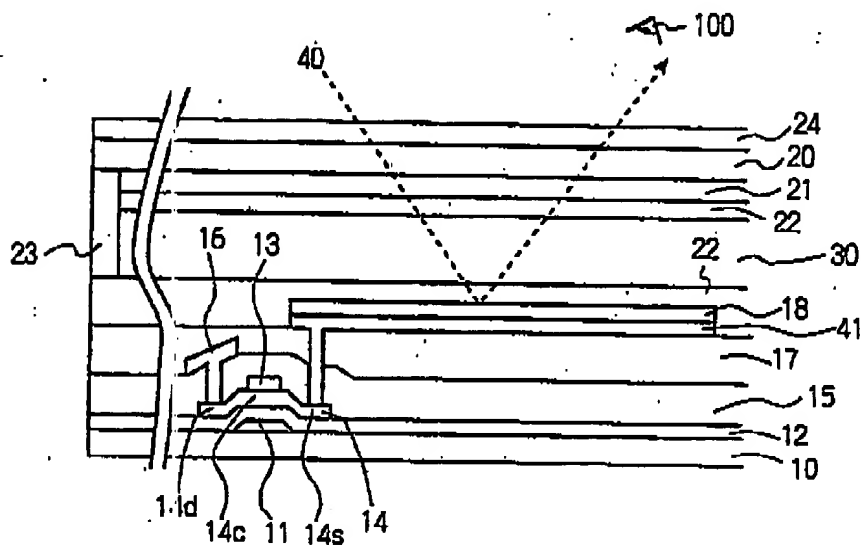
提出日 平成10年 7月31日

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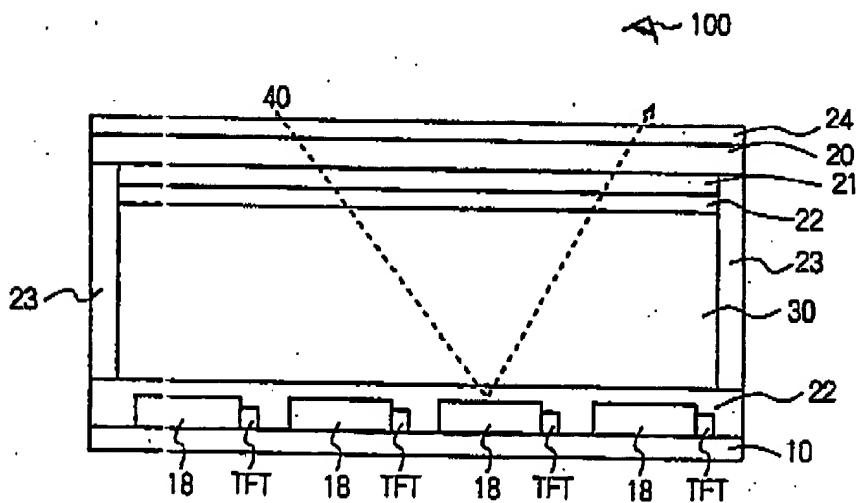
[Name of document]

Drawings

[Fig. 1]



[Fig. 2]



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CANTOR COLBURN, LLP

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ATTACHMENT 2

PATENT ABSTRACTS OF JAPAN

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(71)Applicant : SHARP CORP

(22)Date of filing : 06.08.1998

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(30)Priority

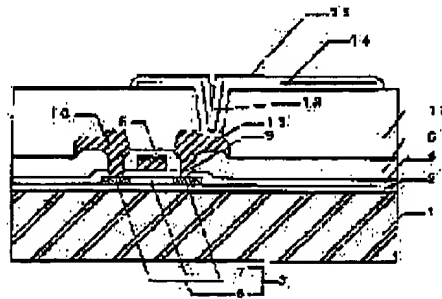
Priority number : 09322712 Priority date : 25.11.1997 Priority country : JP

(54) REFLECTIVE TYPE LIQUID CRYSTAL DISPLAY DEVICE AND ITS MANUFACTURE

(57)Abstract:

PROBLEM TO BE SOLVED: To very easily conduct a microfabrication for the mirror surface reflection electrode having a high reflectivity or a scattering reflection electrode by making a pixel electrode into the reflection electrode that is composed of the laminated layer body, which is made up with a bottom layer electrode and the top layer electrode made of silver or silver alloy and formed to cover surface of the bottom electrode layer.

SOLUTION: A resin insulating film 12 is formed by coating its front surface with polyamide resin or acrylic resin. Then, a contact hole is made open on the film 12, metallic materials such as Cr and Ni or an ITO transparent and electrically conductive thin film are deposited to make an electric contact to a drain electrode 11 and a patterning is made to a prescribed shape to form a substrate electrode 14. Then, a reflection electrode 15 is formed on the electrode 14 using silver by a plating method finally. Since the electrode 15, which becomes a pixel electrode, is formed of silver, a high reflectivity is realized. Moreover, a micropixel electrode pattern is easily formed of silver.

**LEGAL STATUS**

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27.07.2001

[Date of sending the examiner's decision of

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rejection]

[Kind of final disposal of application other than
the examiner's decision of rejection or
application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of
rejection]

[Date of requesting appeal against examiner's
decision of rejection]

[Date of extinction of right]

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